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EXAMINER

RUGGLES, JOHN S

ART UNIT

PAPER NUMBER

1756

DATE MAILED: 05/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/642,657	Applicant(s) KOIKE ET AL.	
	Examiner John Ruggles	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12/27/05 & Exr. amdt. 2/2/06.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5,8-10 and 15 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5,8-10 and 15 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 19 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- ☒ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Applicants are advised that the Notice of Allowance mailed on 2/10/06 is vacated. However, the Examiner's amendment previously authorized in a telephone interview with Attorney Carl Pellegrini on 2/2/06 and mailed on 2/10/06 has been retained. If the issue fee has already been paid, Applicants may request a refund or request that the fee be credited to a deposit account. However, Applicants may wait until the application is either found allowable or held abandoned. If allowed, upon receipt of a new Notice of Allowance, Applicants may request that the previously submitted issue fee be applied. If abandoned, Applicants may request a refund or credit to a specified Deposit Account.

The previously indicated allowability of claims 1-5, 8-10, and 15 is withdrawn in view of newly applied reference(s) to: Jacquinot et al. (US 6,126,518), Miura et al. (US 6,027,669), Grant et al. (Grant & Hackh's Chemical Dictionary, Fifth Edition, 1987), Okamoto et al. (US 6,020,109), Shoki et al. (US 2002/0110743), Maekawa et al. (US 5,868,953), and Yoshikawa et al. (US 2003/0228461). Claims 1-5, 8-10, and 15 are all rejected based on these newly cited reference(s) along with the previously cited references, as set forth below.

Claim Rejections - 35 USC § 102/103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3 are rejected under 35 U.S.C. 102(b) as being anticipated by Miura et al. (US 6,027,669).

Miura et al. teach a polishing composition containing silica (abstract) specifically contemplated to be useful for polishing a substrate such as a photomask (col. 1 lines 3-4). The polishing composition is further described to include colloidal silica, which is known to be made by a process such as hydrolysis of an organic silicon compound (col. 3 lines 26-32, instant claim 1). It is preferred that the colloidal silica polishing composition contains as little metal as possible (col. 3 lines 35-36, instant claim 3 for a content of alkali metal in the colloidal silica for polishing of 0.1 ppm or less). This polishing composition has a pH of at least 7 for excellent stability during processing (e.g., for polishing a photomask containing a silicon dioxide (SiO_2), etc., col. 6 lines 33-53, reading on instant claims 1-2 for a pH of 7.0 to 7.6). Example 9 in Table 1 uses no additive and so would have a pH within 7.0 to 7.6. Examples 3 and 8 may also fall within this pH range based on the small amount of the weak base, potassium carbonate, added to the colloidal manufactured results in an alkali metal content of less than 0.1ppm. This reads on the instant polishing of a glass substrate for a mask blank within the scope of coverage sought, because the instant claims are read to embrace a multilayered substrate where the surface being polished is glass.

Claims 1-3 are rejected under 35 U.S.C. 102(b) as anticipated by Miura et al. (US 6,027,669) in view of Grant et al. (Grant & Hackh's Chemical Dictionary, Fifth Edition, 1987).

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While teaching the polishing of a SiO_2 substrate for a photomask, Miura et al. do not specifically teach the SiO_2 as a glass.

However, Grant et al. specifically defines quartz as being silica or silicon dioxide (SiO_2 , page 487) and further defines silica glass as having over 96% SiO_2 (page 261), so it is clear that the SiO_2 surface of Miura et al. is glass within the accepted meaning of the term.

Claim 2 is rejected under 35 U.S.C. 102(b) as anticipated by or, ~~in the alternative, under~~
~~35 U.S.C. 103(a) as obvious over~~ Jacquinot et al. (US 6,126,518).

Jacquinot et al. teach a process for chemical mechanical polishing of material such as phosphosilicate glass or borophosphosilicate glass by colloidal silica particles at a neutral pH or a pH close to neutral (abstract). In Example 3, borophosphosilicate glass (BPSG) is polished with colloidal silica abrasive particles in suspension at neutral pH (pH=7), which exhibits a higher speed of attack, improved uniformity, and excellent planarization over Experiments 3 and 4 (col. 6 lines 24-51). The preferred conditions for the colloidal silica polishing particles in suspension include a pH of between 6 and 8, particularly a pH of 6.5 to 7.5 (col. 4 lines 12-16), with a neutral pH of 7 being exemplified in Example 3 (col. 5 line 61, reading on the instant pH of 7.0 to 7.6). A polishing process using a suspension of abrasive colloidal silica particles having such a neutral pH or a pH close to neutral (particularly at a pH = 6.5 to 7.5) allows good uniformity of polishing (e.g., of BPSG, etc.) while retaining a good speed of attack and excellent planarization (col. 6 lines 46-51). The instant claim 2 recitation that the glass substrate is "for a mask blank" is an intended use that is not believed to be particularly limiting. Even so, the process of polishing glass by colloidal silica particles at a neutral or nearly neutral pH of 6.5 to 7.5 allows good uniformity for polishing glass while retaining a good speed of attack and excellent

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planarization, as taught by Jacquinet et al., is held to result in a glass substrate inherently able to act as a mask blank for producing a mask useful in lithographic processes for making optical recording media or semiconductor devices (instant claim 2).

Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jacquinet et al. (US 6,126,518) in view of Miura et al. (US 6,027,669).

Jacquinet et al. do not specifically describe the process of forming the colloidal silica.

Miura et al. describe colloidal silica as being formed by hydrolysis of an organic silica compound and the resulting low metal content (col. 3 lines 26-39).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method taught by Jacquinet et al. by using the hydrolysis process of Miura et al. with a reasonable expectation of forming a low metal silica useful for polishing or lapping based upon both references being within this field of endeavor.

Claims 1-3 and 8-10 ⁽¹⁻³⁾ are rejected under 35 U.S.C. 103(a) as being unpatentable over Berkey et al. (US Patent 6,265,115) in view of either Okamoto et al. (US 6,202,109) or Shoki et al. (US 2002/0110743), and further in view of Jacquinet et al. (US 6,126,518) and Miura et al. (US 6,027,669).

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Berkey et al. '115 teach projection lithography photomask blanks, preforms, and methods of making photomask blanks from a glass body that is subsequently post-treated (title, abstract). Photomask blanks and methods of making them suitable for lithography at a wavelength of 193 nm (corresponding to an ArF excimer laser) were previously known and have been popular (col. 2 lines 2-6). As shown by Figure 13, the method of making and post-treatment of photomask blanks taught by Berkey et al. '115 is suitable for photomask blanks used in lithography at

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wavelengths below 193 nm and particularly at 157 nm (vacuum ultraviolet, VUV, from an F₂ excimer laser, col. 10 lines 4-19). Post-treatment of the photomask blanks includes plural successive steps for progressively finer polishing, the last one or two steps of which include polishing the glass photomask blank with aqueous colloidal silica (having an average particle size ≤ 50 nm and a surface area of 200 m²/g or less) that is buffered to a pH of 8 to 12. The combined polishing steps achieve a root mean square (RMS) finished surface roughness ≤ 0.15 nm (col. 13 lines 33-57). The polished glass photomask blank is patterned with a deposited Cr film to form a patterned transmission mask, preferably for use in VUV 157nm wavelength lithography, such as performed with a F₂ excimer laser (col. 13 line 58 to col. 14 line 3, instant claims 9-10).

While teaching methods of preparing a glass substrate for a mask blank to be exposed by either an ArF or an F₂ excimer laser that includes plural successive steps for progressively finer polishing of the glass substrate with aqueous colloidal silica, Berkey et al. '115 do not specifically teach: *[1]* that the colloidal silica has a pH between 7.0 and 7.6 (as required by instant claims 1-2); *[2]* that the colloidal silica was produced by hydrolysis of an organosilicon compound (instant claim 1); *[3]* that the colloidal silica has an alkali metal content of 0.1 ppm or less (instant claim 3); nor *[4]* that the glass substrate is either *[a]* for a phase shift mask (PSM) blank or *[b]* for an EUV reflective mask blank (instant claim 8).

The instant claim 1 colloidal silica abrasive grains are recited to be produced by hydrolysis of an organosilicon compound, which is recognized to be in product-by-process format. Therefore, the colloidal silica abrasive polishing liquid taught by Berkey et al. '115 would appear to be substantially similar to the instant claim 1 polishing liquid containing

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colloidal silica abrasive grains (at least because the average particle size of ≤ 50 nm taught by Berkey et al. '115 clearly reads on Applicants' average particle sizes of 30-200 nm at instant page 22 lines 18-19 and 30-100 nm at instant page 27 lines 4-5, [2]), except that the colloidal silica polishing abrasive taught by Berkey et al. '115 has a pH of 8 to 12, which is higher than the instant pH of 7.0 to 7.6 for the colloidal silica abrasive (as recited by instant claims 1 and 2, on which instant claim 8 depends).

Okamoto et al. teach an exposure method, a phase shift mask (PSM) therefore, and a method of making the PSM (title, abstract). Exposure using the mask with an excimer laser was previously known (col. 2 lines 1-3). The substrate for the PSM is quartz glass (col. 23 lines 51-58). The method of making the PSM with a synthetic quartz glass substrate includes polishing of the glass substrate before sputtering to deposit a light shielding thin film of Cr (to a thickness of e.g., 0.05-0.3 μm , etc.), which is subsequently patterned by wet etching through an overlying patterned resist, as shown in Figures 19-20 (col. 24 lines 55-60, col. 25 lines 5-18, instant claims 8-10, [4][a]). This reference shows the general state of the art for various features of the claimed invention.

Shoki et al. teach an EUV reflection mask blank having a glass substrate polished to a smoothness of 0.12 nm RMS, an intermediate layer, and an absorber layer of Cr and one or more of N, O, and/or C, as well as a process of making the EUV reflection mask (abstract, [0127], [0138], [0162]). The glass substrate is prepared to be superior in smoothness and flatness [0059]. The process of making the EUV reflection mask includes preparation of the glass substrate ([0058]-[0060]), multilayer thin film deposition (e.g., alternating layers of 28 Angstroms (2.8 nm) Mo and 42 Angstroms (4.8 nm) Si [0013], etc.), intermediate layer

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deposition ([0065]-[0068]), absorber layer deposition ([0103]-[0105]), electron beam resist patterning ([0107]-[0110]), and dry etching through the patterned resist to pattern the underlying absorber and the intermediate (optical) layers to make a patterned EUV reflection mask ([0111]-[0118]), as shown by Figure 2 (instant claims 8-10, *[4]/[b]*). This reference shows the general state of the art for various features of the claimed invention.

The teachings of Jacquinet et al. and Miura et al. are discussed above.

It would have been obvious to one of ordinary skill in the art at the time of the invention in the method of producing a glass substrate for a photomask or mask blank (suitable for lithographic exposure by ArF or F₂ excimer lasers) that includes polishing the glass substrate using colloidal silica abrasive having a buffered pH (as taught by Berkey et al. '115), for a PSM (as taught by Okamoto et al., *[4] [a]*), or for an EUV reflective mask (as taught by Shoki et al., *[4] [b]*, reading on instant claim 8) to have alternatively adjusted the pH of the colloidal silica polishing liquid to (1) a pH of 6.5 to 7.5 to allow good uniformity of polishing the glass substrate while retaining a good speed of attack and excellent planarization (as taught by Jacquinet et al.) and (2) a pH of at least 7 for excellent stability during processing while ensuring that the colloidal silica has a low alkali metal content (e.g., for polishing a silicon dioxide photomask substrate, etc., as taught by Miura et al., reading on the instant polishing of a glass substrate for a mask blank by colloidal silica having a pH of 7.0 to 7.6 (instant claims 1-2) that has an alkali metal content of 0.1 ppm or less (instant claim 3), *[1]*, *[3]*) with a reasonable expectation of gaining the benefits described. Further, it would also have been obvious to one of ordinary skill in the art to extend this method using known process steps by forming a thin film for causing optical change, such as a Cr light shielding thin film, on the polished glass substrate for a mask

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blank (instant claim 9) and then patterning the thin film to form a thin film pattern on a mask (e.g., a PSM, an EUV reflective mask, etc., as taught by Okamoto et al. or Shoki et al., instant claim 10).

Claims 4-5 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshikawa et al. (US 2003/0228461) in view of Watanabe et al. (US 6,277,465) and further in view of Maekawa et al. (US 5,868,953).

Yoshikawa et al. teach a method (e.g., in Examples 1 and 2, [0055]-[0059], etc.) for super precision polishing of a glass substrate by first and second super precision polishing steps using silicon dioxide (SiO_2) particles (abstract). In Example 1, the first or primary super precision polishing step on the glass substrate follows rough and precision polishing with cerium oxide and is carried out with a colloidal silica suspension having a pH of 3 at a weighting or pressure of 30 g/cm^2 for 5 minutes to remove 0.3 μm of material (for an average polishing rate of 0.06 $\mu\text{m}/\text{minute}$), while the second polishing step on the glass substrate is carried out with a colloidal silica suspension having a pH of 9.5 at a weighting or pressure of 30 g/cm^2 for 1 minute to remove 0.03 μm of material (for an average polishing rate of 0.03 $\mu\text{m}/\text{minute}$) to obtain an average surface roughness (R_a) of 0.36 nm (paragraphs [0056]-[0058], reading on instant claim 15 for a polishing rate of 0.12 $\mu\text{m}/\text{minute}$ or less to suppress protrusions). The table on page 6 shows comparisons with other examples, including an average surface roughness (R_a) of about 0.2nm to 0.42nm and a peak surface roughness (R_p) of about 1nm to 5nm after super precision polishing.

While teaching plural steps for successively finer polishing on a glass substrate with the latter super precision polishing steps using colloidal silica at low weightings or pressures of 30

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g/cm^2 for successively lower average polishing rates of $0.06\mu\text{m/minute}$ followed by $0.03\mu\text{m/minute}$ to achieve a low R_p , Yoshikawa et al. do not specifically teach plural polishing steps using colloidal silica at successively lower pressures to suppress the occurrence of a fine convex protrusion at the end of the polishing process (instant claims 4-5).

Watanabe et al. teach a glass substrate having a suppressed surface roughness, down to an average surface roughness $\leq 1 \text{ nm}$ (title, abstract). This is achieved by plural polishing steps on the glass substrate, each at successively lower polishing pressures. The first polishing step uses cerium oxide in water at a polishing pressure of $150\text{-}300 \text{ g/cm}^2$ (col. 4 lines 33-56). The second polishing step also uses cerium oxide in water, but at a polishing pressure of $25\text{-}150 \text{ g/cm}^2$ (col. 4 line 57 to col.5 line 3). The third polishing step uses colloidal silica (grain size of 0.2 microns or less) in water as the polishing liquid at a polishing pressure of $25\text{-}100 \text{ g/cm}^2$ (col. 5 lines 4-20). While this glass substrate is intended to be used for a magnetic information recording medium (title, abstract), this method of successively polishing the glass substrate is believed to be equally suitable for achieving a similar average surface roughness for a glass substrate intended for making a mask blank.

Maekawa et al. teach a method for polishing a glass substrate (abstract) having an improved surface characteristic (col. 1 lines 5-6) that includes plural polishing steps. Example 1 describes a first polishing of the glass substrate with a cerium oxide slurry in water having a pH of 7.4 at a polishing load or pressure of 120 g/cm^2 and then a second polishing of the glass substrate with colloidal silica having a pH of 9.5 at a polishing load or pressure of 60 g/cm^2 to obtain an average surface roughness (R_a) of 18 Angstroms (1.8 nm, col. 8 lines 40-62).

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It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Yoshikawa et al. by increasing the weighting or pressure from 30 g/cm² during the primary polishing step of the super precision polishing to reduce the time required based upon the teachings of the use of lower pressures in successive polishing steps by Watanabe et al. and Maekawa et al. Clearly, the increased pressure on the abrasive during earlier polishing step(s) would result in more aggressive polishing. Applicants are invited to compare the average and peak surface roughness after polishing achieved by the instant process with the results for average surface roughness (Ra) and peak surface roughness (Rp) after super precision polishing in the table on page 6 of Yoshikawa et al., noting that the Rp of Yoshikawa et al. is less than the 2 nm minimum peak height discussed by the instant specification in the last line on page 22 and that only examples 2-1, 2-2, 2-3, and 2-6 had final polishing pressures less than the 30 g/cm² used by Yoshikawa et al. in the secondary and final super precision polishing step. It is further noted that patterned masks would include those used to form optical recording media as well as those used to form semiconductor devices.

Claims 4-5, 8-10⁽⁴⁰⁾, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoshikawa et al. (US 2003/0228461) in view of Watanabe et al. (US 6,277,465) and Maekawa et al. (US 5,868,953), further in view of Berkey et al. (US Patent 6,265,115) and either Okamoto et al. (US 6,202,109) or Shoki et al. (US 2002/0110743).

While teaching methods for progressively finer polishing of a glass substrate by colloidal silica for various aspects of the claimed invention, Yoshikawa et al., Watanabe et al., and Maekawa et al. do not specifically teach: **[4]** that the glass substrate is **[a]** for a PSM blank to be exposed by either an ArF or an F₂ excimer laser or **[b]** for an EUV reflective mask blank (instant

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claim 8); [5] that a thin film for causing an optical change in exposure light is formed on the glass substrate (instant claim 9); nor [6] that the thin film is patterned to produce a mask (instant claim 10).

The teachings of Berkey et al. '115, Okamoto et al., and Shoki et al. are discussed above.

In addition to the basis given above, the examiner further holds that it would have been obvious to use the process for polishing other glass substrates, such as those for a PSM blank to be exposed by either an ArF or an F₂ excimer laser or for an EUV reflective mask blank (instant claim 8, [4][a], [b]), as disclosed by Berkey et al. '115, Okamoto et al., and/or Shoki et al. in making UV photomasks or masks. Furthermore, it would also have been obvious to use the resulting polished glass substrates to form a useful mask by providing a thin film for causing an optical change in exposure light on the glass substrate to produce a mask blank (instant claim 9, [5]) and then patterning the thin film to produce a mask (instant claim 10, [6]), as taught by Berkey et al. '115, Okamoto et al., and/or Shoki et al., with a reasonable expectation of forming a useful photomask or mask.

Response to Arguments

Applicants' arguments with respect to claims 1-5, 8-10, and 15 have been considered but are moot in view of the new ground(s) of rejection set forth above.

Conclusion

The prior art made of record and not relied upon is considered pertinent to Applicants' disclosure.

Takami et al. (US 6,626,967) teaches a polishing method and a colloidal silica polishing composition therefore (title, abstract) that has a pH of 5 to 8, and preferably a pH of 6 to 7.5, to

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ensure that the colloidal silica is close to neutral in pH so that the amount of hydroxyl groups is sufficiently reduced to particularly suppress agglomeration of the colloidal silica. The polishing results are remarkable for such a colloidal silica polishing composition having a neutral pH, which is also beneficial for handling efficiency and safety, as well as in consideration of the environment (col. 5 lines 50-60).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

John Ruggles
Examiner
Art Unit 1756



MARTIN ANGEBRANNT
PRIMARY EXAMINER
GROUP 1100-1756